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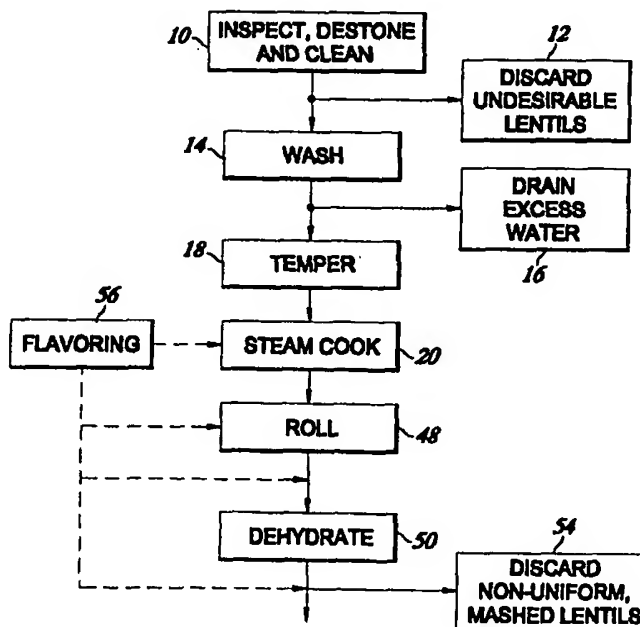
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(54) Title: PROCESS FOR PRODUCING DEHYDRATED WHOLE LENTILS

(57) Abstract

A process for producing reconstitutable, dehydrated, whole lentils which includes providing a quantity of uncooked, dried lentils, tempering the lentils by immersion in water (18), draining excess water from same, allowing the lentils to stand for a time sufficient to acquire a moisture content substantially equilibrated throughout the lentils, cooking said lentils in a steam environment for a period of time sufficient to soften them (20), and passing said lentils through a gap between two smooth rollers such that the pericarp outer covering is cracked without penetrating the cotyledon inner seeds (48). Depending on the chosen size of the gap, either no cotyledon inner seed is exposed or up to one millimeter of seed can be exposed. The resulting lentils are then dehydrated (50) and can be easily reconstituted as a ready-to-eat food product.



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PROCESS FOR PRODUCING DEHYDRATED WHOLE LENTILS**Field of the Invention**

The present invention relates generally to legume
5 food products, and more particularly to a process for
producing dehydrated whole lentils which are quickly
reconstitutible and having the qualities of conventional
cooked fresh lentils.

10 Background of the Invention

Food plants which have a pod that opens along two
seams when the edible seeds are ripe are known as
legumes. Peas, beans, peanuts, and lentils are the most
popular legumes, though there are many other species.
15 Legumes are an important food for humans around the
world, and are easily grown under varying soil and
climatic conditions. In particular, the lentil is small
and lens-shaped, and is never used green but is dried
when it is fully ripe. In America, lentils are most
20 generally eaten in soup, though elsewhere they are a
staple food which appears in stews, salads, and other
standard dishes. There are two varieties of lentils:
the French variety, grey outside, yellowish inside, and
sold with the seed coat on; and the Egyptian variety,
25 reddish-yellow, smaller and rounder, without a seed coat.
Lentils nutritionally are a good source of carbohydrates
and incomplete protein, and also contain some B vitamins,
iron, calcium, and Vitamin A.

Traditionally, lentils are prepared by soaking in a
30 pot containing water, adding more water and covering the
pot, bringing the water to a boil, and reducing the heat
and gently cooking the lentils for at least two hours.
Although such a method has proven generally suitable for
preparing fresh lentils for eating, the time-consuming
35 preparation detracts from the overall desirability of
serving lentils.

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In view of the time-consuming preparation of fresh lentils, whole lentils or lentil soups are generally available either in cans packed in water, in a sealed vapor pouch having intermediate moisture, or dehydrated (usually dried in a frozen state under high vacuum). The canned lentils are bulky, creating a storage and transportation problem. The canned, vapor pouch and freeze-dried lentils are perceived as a lower quality food product not having the color, appearance, texture, and consistency of conventionally prepared fresh lentils. Also, the freeze-dried lentils are not immediately reconstitutable, but typically require heat and stirring to achieve the transformation to whole lentils or lentil soup. And even despite the proper mixing of water and freeze-dried lentils, small lumps generally remain causing the resultant product to have a sandy-mouth feel. As such, the prior art has recognized the problem of the time-consuming preparation of lentils, though the proposed solutions have, to date, been ineffective in providing a satisfactory remedy.

Summary of the Invention

The present invention specifically addresses and alleviates the above-mentioned deficiencies associated with the prior art. Generally, the present invention comprises a process for producing dehydrated whole lentils which are quickly reconstitutable into a food product having the qualities of conventional cooked lentils. The process generally comprises the steps of: providing a quantity of uncooked, dried lentils; tempering the lentils; cooking the lentils in steam; cracking the pericarp covering of the lentils; and dehydrating the lentils.

In a preferred embodiment of the invention, the tempering step includes the operations of: immersing the lentils in water causing significant absorption; draining

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the excess water; and allowing the lentils to stand such that the moisture equilibrates throughout.

Also in a preferred embodiment of the invention, the step of cracking the pericarp covering is accomplished by directing the lentils between a pair of opposing smooth rollers. If whole lentils are the desired resultant product, the cotyledon seed should not be exposed outside the pericarp covering. If lentil soup is the desired resultant product, the pericarp covering should be broken such that approximately one millimeter of the cotyledon seed is exposed. The cracking of the pericarp covering is preferably carried out by flattening the lens-shaped lentils between opposing sides. By employing smooth rollers only, as opposed to corrugated rollers that penetrate the cotyledon, the cotyledon substantially retains its natural structure, both initially and after processing and reconstitution, to thereby maintain a more natural food product.

The resultant food product is reconstitutable into whole lentils or lentil soup upon placement in hot water for approximately one minute, without requiring continuous mixing. The whole lentils or lentil soups have the color, appearance, texture and consistency of conventionally prepared fresh lentils. These, as well as other advantages of the present invention will become more apparent from the following description and drawings. It is understood that changes in the process described may be made within the scope of the claims without departing from the spirit of the invention.

30

Brief Description of the Drawings

Figure 1 is a flowchart illustrating the sequence of operations performed in the practice of the preferred process of the present invention;

35 Figure 2 is a front elevational view of a rotary steam cooker which may be used in the practice of the process of the present invention;

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Figure 3 is a partial cross-sectional view of a continuous screw steam cooker which may be used in the practice of the process of the present invention.

5 **Detailed Description of the Preferred Embodiment**

 The detailed discussion set forth below in connection with the appended drawings is intended as a description of the presently preferred process of the invention, and is not intended to represent the only form
10 in which the present invention may be practiced. The description sets forth the functions and sequence of steps for practicing the invention in connection with the preferred process. This is to be understood, however, that the same or equivalent functions and sequences may
15 be accomplished by different processes that are intended to be encompassed within the spirit and scope of the invention.

 The process for producing dehydrated whole lentils is generally illustrated in Figure 1 which depicts the
20 presently preferred process of the invention. The preferred process generally comprises the steps of inspecting and cleaning, washing, tempering, steam cooking, rolling, and dehydrating the lentils. The lentil product produced by the present process forms an
25 instantly reconstitutable food product having the color, appearance, texture, aroma, and consistency of conventionally prepared fresh whole lentils or lentil soup. The resultant dehydrated lentil product will have a moisture content of approximately 2% to 10%, with the
30 preferred moisture content being approximately 5%. The present process is practiced upon lentils of the French variety, sold with the seed coat on.

 The individual steps of the present process will now be discussed for ease in understanding the subject
35 invention.

 The initial inspection, de-stoning, and cleansing operation 10 of the lentils to remove unwanted materials

is carried out manually or automatically in accordance with known methods of the prior art. The lentils are typically received in tote bags or hoppers, and undesirable or otherwise substandard lentils are discarded 12.

After inspection and cleaning 10, the lentils are washed 14 in ambient temperature water, or any acceptable liquid capable of removing foreign material such as dirt and pesticides. Following washing, the lentils are drained 16 and the excess water is discarded. After being washed, the lentils are tempered 18, preferably by being immersed in ambient temperature water until the lentils (initially approximately 10% water weight) reach 30% to 60% water weight (usually for one to six hours), but preferably 46% water weight (about three hours). The water temperature should not exceed about 85°F, as higher temperatures may lead to spoilage due to rapid bacterial growth and/or loss of natural flavors. Continuing the tempering operation, the water is then drained, and the lentils set aside and left to stand for approximately three hours at ambient room temperature. This conditioning allows the moisture to equilibrate itself throughout the lentils to provide uniform softness.

Upon completion of the tempering 18, the lentils are steam cooked 20 with direct injected live steam in a low pressure steam environment at approximately 15 PSIG. The cooking time depends upon the exact pressure, and desired texture, but approximately 10 to 20 minutes.

The lentils are preferably placed in a rotating, substantially closed steam vessel to assure continuous contact of the lentils to the steam at the low cooking pressure. The rotating steam vessel rotates the lentils such that the same are continuously being tumbled and evenly exposed to steam so as to facilitate the cooking of the lentils equally. As those skilled in the art would recognize, the cooking could also be accomplished

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by boiling the lentils in water or exposing the lentils to infrared heat sources, microwaves, etc.

The cooking of the lentils is preferably accomplished through utilization of a continuous screw steam cooker 22 as shown in Figure 3. The continuous screw steam cooker 22 is adapted to provide a steady output, and is used by placing the lentils into a hopper 24 from which they are carried by a screw 26 through a housing 28 toward an outlet 30. Steam is applied to the housing 28 through tubes 32 and contained therein by doors 34. The volumes of steam supplied through the tubes 32 may be varied along the length of the steam cooker 22.

As an alternative to the continuous screw steam cooker 22, the lentils may be cooked in a rotary steam cooker 36 as shown in Figure 2. The rotary steam cooker 36 typically has a capacity of approximately 14 cubic feet and rotates the lentils contained therein to assure even and thorough cooking. Steam is provided via an intake line 38 from which it travels through a coupling nut 40 and tube 42 into a housing 44. A lid 46 provides a means for placing the lentils into and removing the lentils from the rotating steam cooker 36. The steam cooker 36 is typically alternatively supplied with steam and then rotated. Injection of steam into the housing 44 when rotary steam cooker is in an upright position (with the lid 46 uppermost) ensures even distribution of the steam throughout the lentils within the housing 44. Subsequent rotation of the rotary steam cooker 36 mixes the lentils to further ensure uniform heat distribution.

Subsequent to being cooked, the lentils are conveyed to the roller mills. In the rolling operation 48, the lentils are smoothly cracked between one pair of opposing smooth rollers. The rolling operation flattens the lens-shaped lentils so as to flatten the lentils between the opposing sides, causing a crack in a pericarp covering. The pair of smooth rollers have an adjustable roll gap

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set at from about 0.070 to about 0.110 inch to flatten the lentils between their opposing sides and accomplish the cracking of the pericarp. The lens-shaped lentils are oriented such that they are pressured between their opposing sides, the orientation accomplished by feeding individual lentils near the top of either roller such that the lentils lay parallel with the surface as they travel through the gap. If, alternatively, the desired product is dehydrated lentils for use in making lentil soup rather than dehydrated whole lentils, the roll gap is decreased to about 0.050 to about 0.070 inch to thereby cause greater pressure to be applied to the lentils, such that approximately one millimeter of the cotyledon is expressed outside the pericarp. The cotyledon outside the shell provides thickening and body to the resultant soup when the dried lentils are reconstituted with water. If a thicker soup is desired, a bigger crush may be imposed on the lentils to cause a greater portion of the cotyledon to be expressed outside the pericarp.

After undergoing the rolling operation 48, the lentils are then dehydrated 50. The drying of the lentils is accomplished by the passage of the lentils into an atmospheric dryer, preferably a compartmentalized oven having independent sectional controls for temperature and humidity. Care must be taken not to overheat the lentils so as to "toast" the resultant product. As previously indicated, upon merging from the air drying operation, the lentils have a moisture content of preferably from 4% to 6%.

Once the lentils have been subjected to aforementioned dehydration process 50, they are preferably sized so as to have a substantially uniform shape and size for aesthetics and more uniform packaging density. In the sizing process 52, the lentils may be passed through a power sieve whereby larger lentils are reduced in size. Also alternatively, the sieve may be

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used to provide a portion of the lentils comminuted for use in soup or casseroles. Thereafter, the lentils are packaged for storage and/or shipping.

5 The dehydrated lentil product formed in accordance with the aforementioned process is reconstituted simply by adding water thereto. In particular, the lentil product reconstitutes in hot water within approximately four minutes, and reconstitutes in cold water in approximately twenty minutes. Importantly, the
10 reconstitution of the lentil product occurs without constant stirring. Despite not being constantly stirred, the lentil product is not afloat on the top surface of the water during reconstitution. The air dried lentil product is economical to produce, and has a shelf life of
15 at least one year.

It is understood that the process described herein as shown in the drawings represents only a presently preferred practice of the invention. Indeed, various modifications and additions herein made to the preferred
20 process without departing from the spirit and scope of the invention. These and other modifications and additions may be obvious to those skilled in the art and may be implemented to adapt the present invention for use in a variety of different applications.

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WHAT IS CLAIMED IS:

1. A process for producing reconstitutible, dehydrated, whole lentils, the process comprising the steps of:

- 5 a) providing a quantity of uncooked, dry lentils having a cotyledon inner seed and a pericarp outer covering of a generally lens shape with a pair of opposing sides;
- 10 b) tempering the lentils by immersion in water for a period of time sufficient for the lentils to absorb water to reach from about 125% to about 225% of original weight, draining remaining excess water from the lentils, and allowing the lentils to stand for a time sufficient to acquire a
- 15 moisture content substantially equilibrated throughout the lentils;
- c) cooking the lentils in a steam environment for a period of time sufficient to soften the lentils;
- 20 d) cracking the pericarp outer covering of the cooked lentils by passing the lentils between two opposing smooth rollers having a gap therebetween sufficient to crack said covering without exposing the cotyledon inner seed; and
- 25 e) dehydrating the cooked lentils having the cracked pericarp outer covering.

2. A process as claimed in Claim 1 wherein the moisture content substantially equilibrated throughout the lentils is from about 30% to about 60% by volume of

30 the lentils.

3. A process as claimed in Claim 2 wherein the steam environment is at a pressure of from about 10 to about 20 PSIG.

4. A process as claimed in Claim 3 wherein the

35 steam environment is a continuous screw steam cooker.

5. A process as claimed in Claim 3 wherein the steam environment is a rotary steam cooker.

6. A process as claimed in Claim 3 wherein the gap between the rollers is from about 0.070 and about 0.110 inch.

7. A process as claimed in Claim 3 wherein the
5 cooked lentils are dehydrated to a moisture content of from about 2% to about 10% by volume.

8. A process as claimed in Claim 1 wherein the gap between the rollers is from about 0.070 and about 0.110 inch.

10 9. A process as claimed in Claim 1 wherein the cooked lentils are dehydrated to a moisture content of from about 2% to about 10% by volume.

10. A process for producing reconstitutible, dehydrated, whole lentils, the process comprising the
15 steps of:

a) providing a quantity of uncooked, dry lentils having a cotyledon inner seed and a pericarp outer covering of a generally lens shape with a pair of opposing sides;

20 b) tempering the lentils by immersion in water for a period of time sufficient for the lentils to absorb water to reach from about 125% to about 225% of original weight, draining remaining excess water from the lentils, and allowing the
25 lentils to stand for a time sufficient to acquire a moisture content substantially equilibrated throughout the lentils;

c) cooking the lentils in a steam environment for a period of time sufficient to soften the
30 lentils;

d) cracking the pericarp outer covering of the cooked lentils by passing the lentils between two opposing smooth rollers having a gap therebetween sufficient to crack said covering and
35 expose about one millimeter of the cotyledon inner seed; and

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e) dehydrating the lentils having the cracked pericarp outer covering.

11. A process as claimed in Claim 10 wherein the moisture content substantially equilibrated throughout
5 the lentils is from about 30% to about 60% by volume of the lentils.

12. A process as claimed in Claim 11 wherein the steam environment is at a pressure of from about 10 to about 20 PSIG.

10 13. A process as claimed in Claim 12 wherein the steam environment is a continuous screw steam cooker.

14. A process as claimed in Claim 12 wherein the steam environment is a rotary steam cooker.

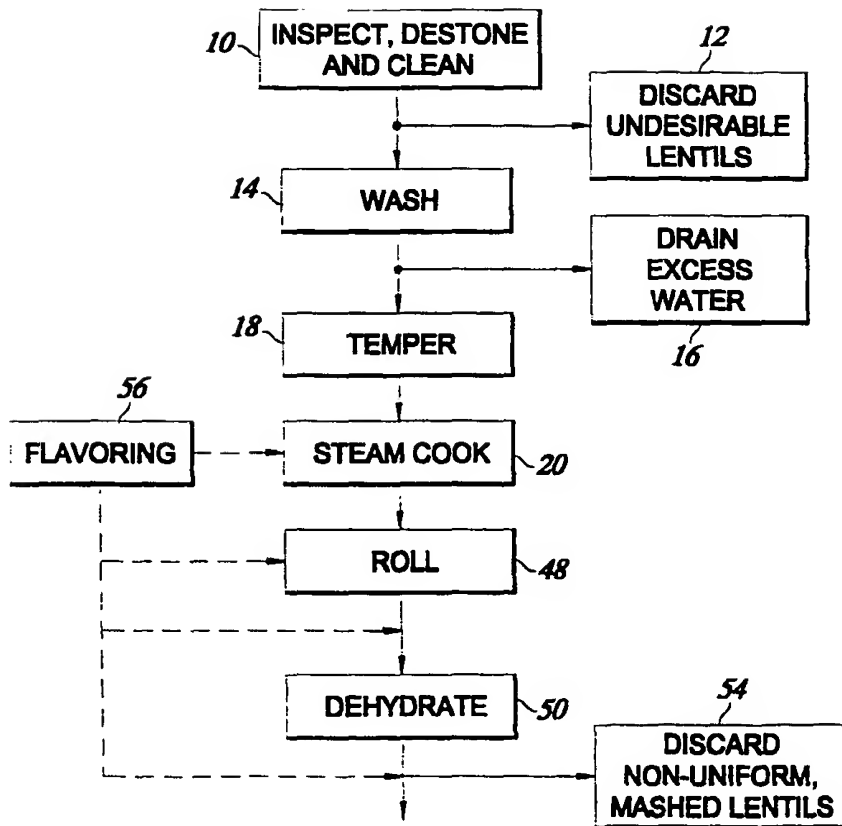
15 15. A process as claimed in Claim 12 wherein the gap between the rollers is from about 0.050 and about 0.070 inch.

16. A process as claimed in Claim 10 wherein the gap between the rollers is from about 0.050 and about 0.070 inch.

20 17. A process as claimed in Claim 12 wherein the cooked lentils are dehydrated to a moisture content of from about 2% to about 10% by volume.

18. A process as claimed in Claim 10 wherein the cooked lentils are dehydrated to a moisture content of
25 from about 2% to about 10% by volume.

19. A process as claimed in Claim 10 wherein the gap between the rollers is from about 0.050 and about 0.070 inch.

*Fig. 1*

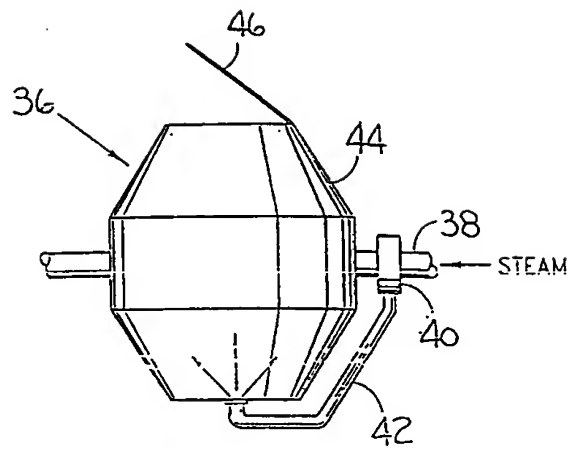


FIG. 2

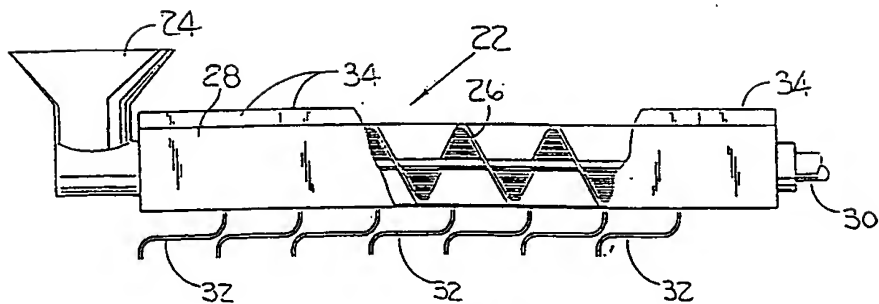


FIG. 3

ZONE #	Pre Product Temp.	Set Point	Post Product Temp	Dew Point
ZONE #1	TEMP 273	260	189	59
ZONE #2	TEMP 234	235	221	61
ZONE #3	TEMP 177	160	171	45
ZONE #4	TEMP 166	160	164	43
ZONE #5	TEMP 159	160	147	40

Fig. 4

INTERNATIONAL SEARCH REPORT

 International application No.
 PCT/US97/15732

A. CLASSIFICATION OF SUBJECT MATTER IPC(6) :A23L 1/20 US CL :426/460, 461, 465, 511, 634 According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) U.S. : 426/460, 461, 465, 511, 634 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,871,567 A (STERNER ET AL) 3 OCTOBER 1989, SEEN ENTIRE DOCUMENT.	1-19
Y	US 5,124,170 A (STERNER ET AL) 23 JUNE 1992, SEE ENTIRE DOCUMENT.	1-19
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